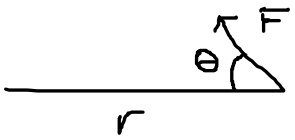
Review for Test Next Class:

Statics

$\tau_c=\tau_{cc}$

$\tau=Fr\sin\theta$

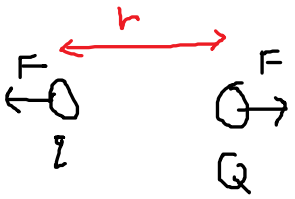


$F_{up}=F_{down}$

$F_{right}=F_{left}$

Electrostatics

like charges repel
opposite charges attract



$F_e = kQq/r^2$

$k=9.00\times10^9 Nm^2/C^2$

$E=F/q$ general equation

point charge $E=kQ/r^2$
multiple point charges - vector sum of all Es

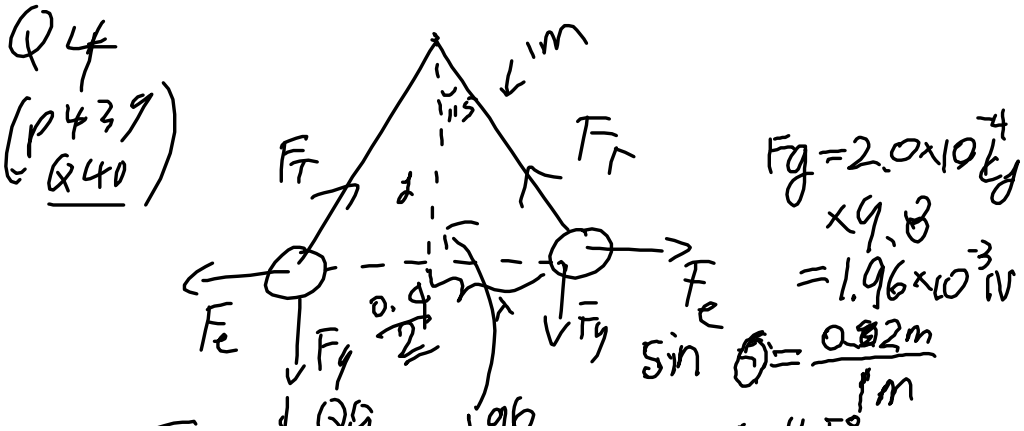
Energy, $\Delta E_e= qEd$ in a uniform field

$E_e=kQq/r$

Potential or Voltage $V=E_e/q$ units Volts, V=J/C

around a point charge, V=kQ/r
multiple point charges add Vs (not a vector)

P456 Q1-15odds

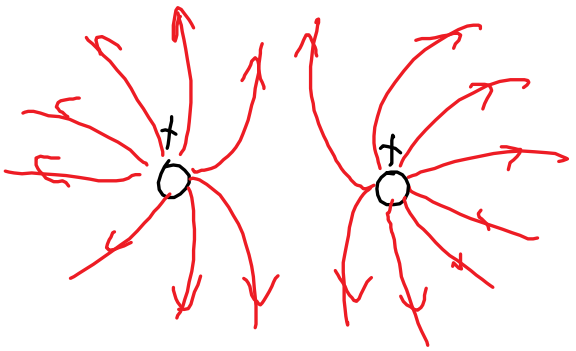


$F = \frac{kQq}{r^2}$ $\quad 4\times10^{-3} = \frac{9\times10^{9}\, q^2}{(0.4)^2}$ $\quad q = 8.4 \times 10^{-8}\,C$

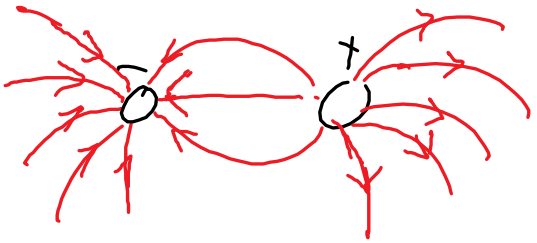
$\sin\theta = \frac{0.02\,m}{1\,m}$ $\quad \theta = 11.5°$ $\quad \frac{\Delta}{y} = \tan\theta$ $\quad \tan 11.5 N\, 8\times10^{-4} N = 4\times10^{-4} N$

1. touch the electroscope with vinyl strip, charging it negative, and leaves will repel
   - bring the comb close to the electroscope and see if the leaves go apart (negative) or go together (positive)
2.

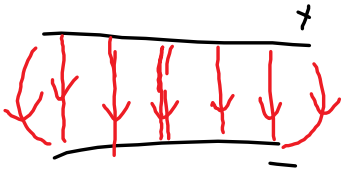
a)



b)



c)



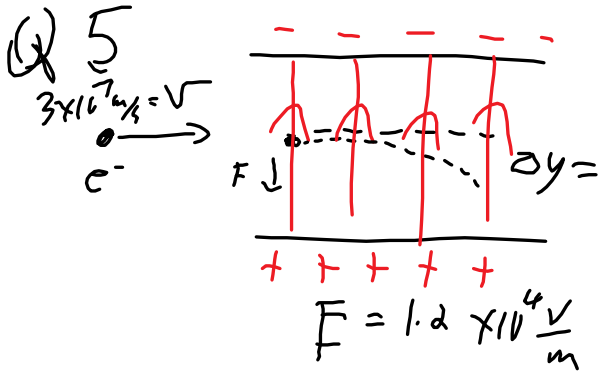
3. $F = \frac{kQq}{r^2}$

$\frac{\text{New } F}{F} = \frac{\frac{k\frac{1}{2}Q3q}{(5r)^2}}{\frac{kQq}{r^2}} = \frac{\frac{1}{2}\cdot 3}{25} = \frac{3}{50}$

$= \frac{5}{50}$ of original

$a = \frac{F}{m} = \frac{Eq}{m}$

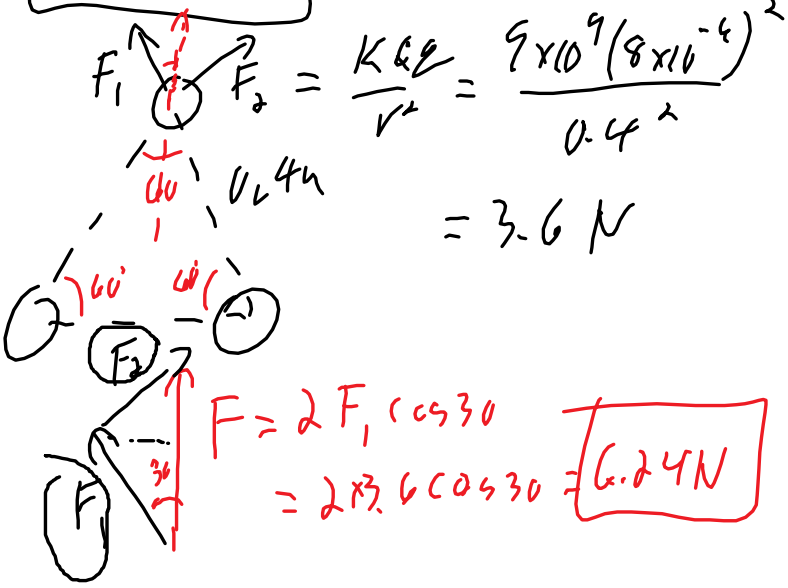
5



$$\Delta y = \frac{1}{2}\frac{Eq}{m}\left(\frac{dx}{V_x}\right)^2 = \frac{1}{2}\frac{1.2\times10^4(1.6\times10^{-19})(0.12)^2}{9.11\times10^{-31}(3\times10^7)^2}$$

$$= 0.017\,m$$

6



Q7

a) V=Ed so E = V/d = 100V/0.04m = 2500N/C
F=Eq = 2500x1.6=4000 = 4.0×10^{-16}N

b) E = V/d = 2500N/C or E=F/q

c) a=F/m = Eq/m = 2500x1.6/9.11=439.0779
$4.39 \times 10^{14} m/s^2$
$d=1/2at^2$ t= root(2d/a) =
Sqrt(2x0.04/4.390779)=0.134993461412565 =
1.4×10^{-8} s

8a) $E=kQ/r^2 = 9.0x10^9(2x1.6x10^{-19})/(1x10^{-9}m)^2$
$= 2.9x10^9 N/C$

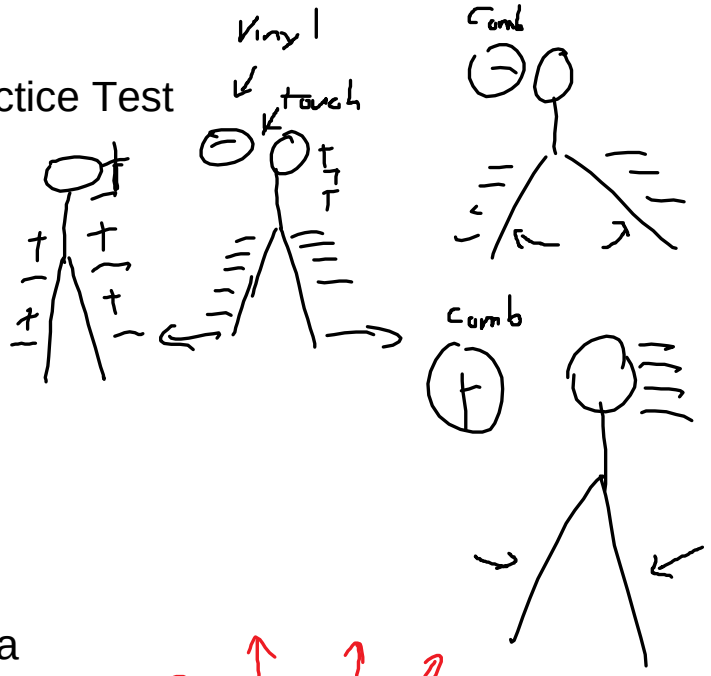
b) $V=kQ/r = 2.9V$

c) $E_e=kQq/r = 2.9eV = 4.6x10^{-19}J$

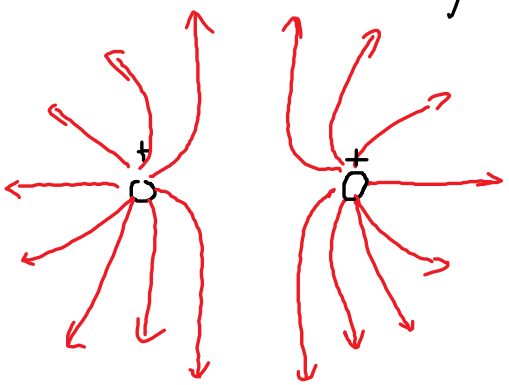
9 $W=\Delta E_e = kQq\ (1/rf - 1/ri) =$
$9.0x10^9(1.0C)^2\ (1/(3.0x10^3) - 1/(5x10^3))$
$= 1.2x10^6 J$

Practice Test

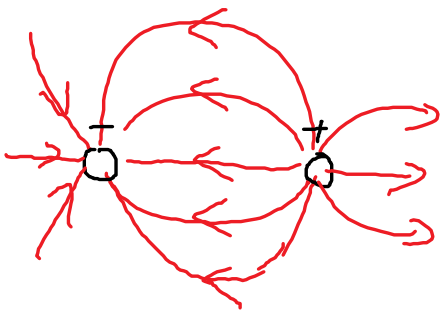
Q1



Q2 a

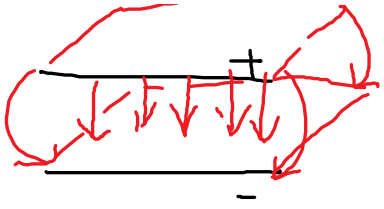


b)



c)

c)



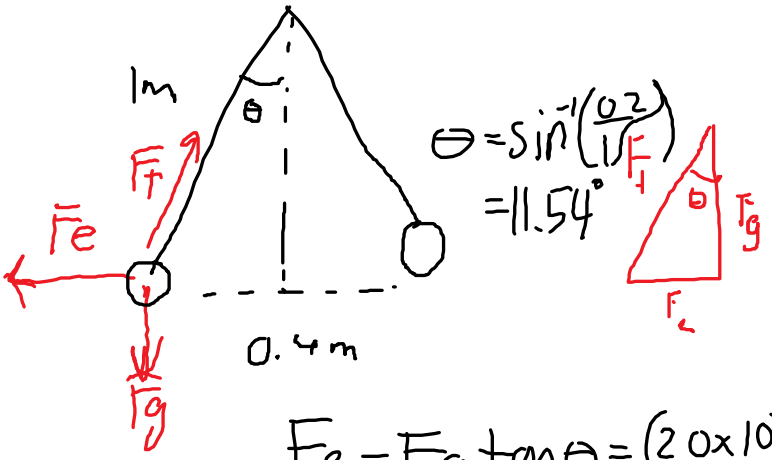
Q3

$F_2 = xF_1$

$\frac{k\frac{1}{2}Q3q}{(5r)^2} = x\frac{kQq}{r^2}$

$\frac{3}{50} = x$

Q4

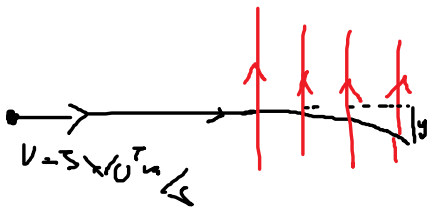


$\theta = \sin^{-1}\left(\frac{0.2}{1}\right) = 11.54°$

$Fe = Fg\tan\theta = (2.0\times10^{-4})(9.8)\tan 11.54 = 4.00\times10^{-4}$

$F_e = \frac{kQq}{r^2}$ $\quad Q^2 = \frac{Fcr^2}{k} = \sqrt{\frac{(4.00\times10^{-4})(0.4^2)}{9.00\times10^9}} = 8.4\times10^{-8}\,C$

Q5



$d_y = \frac{1}{2}at^2$

$a = \frac{F}{m} = \frac{Eq}{m}$

$t = \frac{dx}{vx}$

$d_y = \frac{t}{2}$

Practice Test

Q1 Vinyl strip is negative

take vinyl strip and touch to electroscope,

charging it and leaves spread

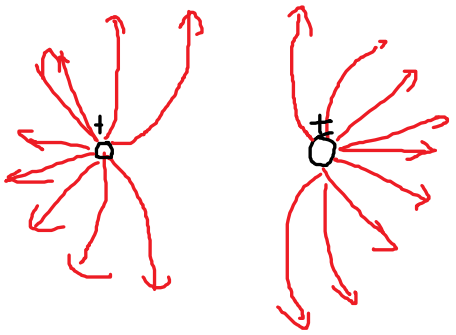
take comb and bring near electroscope

if leaves go closer, comb is positive

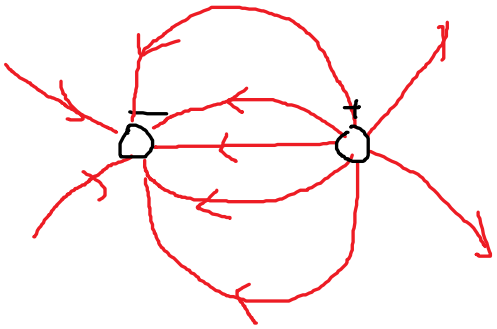
if leaves go further it is negative

if leaves go closer, comb is positive
if leaves go further it is negative

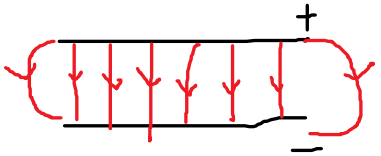
Q2a)



b)



c)



Q3

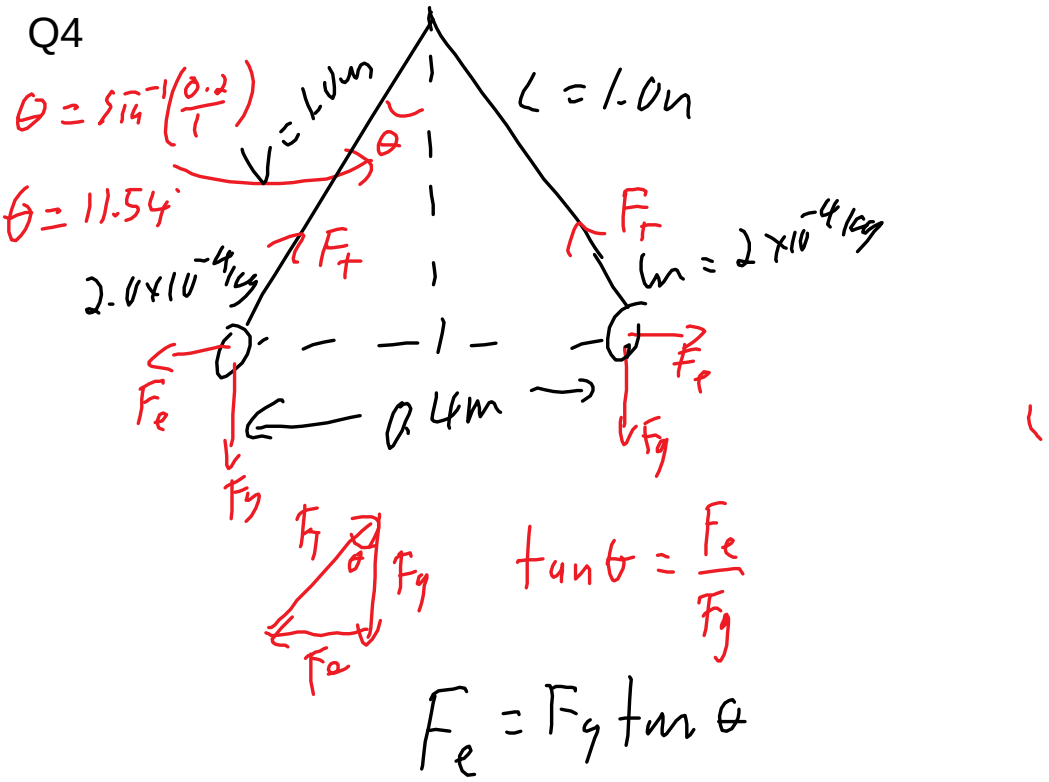
$F_1 = kQq/r^2$

$F_2 = k\,(1/2Q)(3q)/(5r)^2$

$F_2 = (3/50)\,kQq/r^2$

$F_2 = (3/50)F_1$

Q4



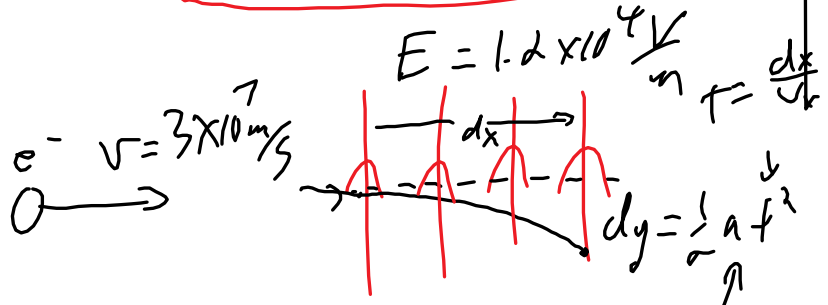
$$\frac{kQ^2}{r^2} = mg\tan\theta$$

$$Q = \sqrt{\frac{r^2 mg\tan\theta}{k}}$$

$$Q = \sqrt{\frac{(0.4)^2(2\times10^{-4})(9.8)\tan(11.54^\circ)}{9\times10^9}}$$

$$Q = \boxed{8.4\times10^{-8}\ C}$$

Q5



$$F_e = ma = Eq$$

$$a = \frac{Eq}{m}$$

$$d_y = \frac{1}{2}\frac{Eq}{m}\left(\frac{dx}{v_x}\right)^2$$

$$= \frac{1}{2}\frac{(1.2\times10^4)(1.6\times10^{-19})}{9.11\times10^{-31}}\left(\frac{0.12}{3\times10^7}\right)^2$$

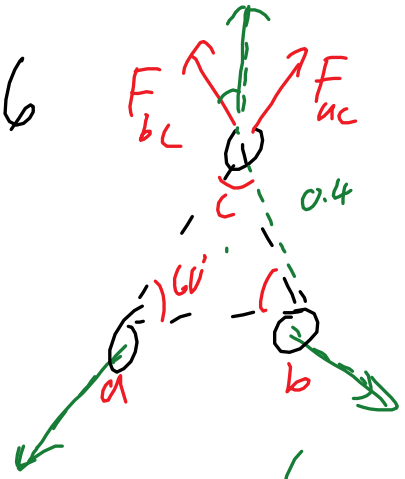
$$= \boxed{0.017\ m}$$

$E = \frac{V}{d}$

$\Delta V = Ed$

$\Delta E_e = qEd$

Q6



$$F = 2\frac{kQq}{r^2}\cos\theta$$

$$F = 2\frac{(9\times10^9)(6\times10^{-6})^2}{(0.4)^2}\cos 30°$$

$$F = 6.24\,N \text{ - radially out}$$

7a) $F = Eq = 2500\,N/C \times 1.6\times10^{-11}\,C$

$= 4.0\times10^{-16}\,N$

b) $E = \frac{V}{d} = \frac{100\,V}{0.04\,m} = 2500\,N/C$

c) $d = \frac{1}{2}at^2$ $\quad t = \sqrt{\frac{2d}{a}}$

$$t = \sqrt{\frac{2(0.04)}{4\times10^{16}/9.11\times10^{-31}}} = 1.3\times10^{-8}\,s$$

Q8 a) $E = \frac{kQ}{r^2} = \frac{9\times10^9\,(2\times1.6\times10^{-19})}{(1\times10^{-9})^2}$

$= 2.9\times10^9\,N/C$

$= 2.9 \times 10^{9}\ N/C$

b) $V = \frac{kQ}{r} = \frac{9 \times 10^{9}\,(2 \times 1.6 \times 10^{-19})}{(1 \times 10^{-9})}$

$= 2.88\ V$

c) $E_e = \frac{kQq}{r} = Vq = 2.88\ eV$

$= 4.5 \times 10^{-19}\ J$

Q9

$W = E_{ef} - E_{ei}$

$= kQq\left(\frac{1}{r_f} - \frac{1}{r_i}\right)$

$= 9 \times 10^{9}(1.0C)^2\left(\frac{1}{3 \times 10^{3}} - \frac{1}{5 \times 10^{3}}\right)$

$= 1.2 \times 10^{6}\ J$